REMARKS

The Office Action dated July 9, 2008 has been received and carefully noted. The above amendments to the claims, and the following remarks, are submitted as a full and complete response thereto.

Claims 2, 3, 12, and 13 have been canceled without prejudice or disclaimer. Claims 1, 4, 6-11, 14, and 16-19 are therefore currently pending in the application and are respectfully submitted for consideration.

Claims 2, 3, 12, and 13 were objected to under 37 C.F.R. §1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. As mentioned above, claims 2, 3, 12, and 13 have been canceled. As such, this objection is rendered moot.

Claims 1-4, 8, 10-14, and 18 were rejected under 35 U.S.C. §103(a) as being unpatentable over Pikkarainen et al. (US 5,701,106), and further in view of Lipka (US 7,227,910). The Office Action took the position that Pikkarainen discloses all of the elements of the present claims, with the exception of "transmitting the RF signal," and "wherein the performing of the delta sigma modulation comprises performing 2nd order delta sigma modulation to output 4 bits from a 10 bit input." The Office Action took the position that Pikkarainen inherently discloses transmitting the RF signal, and cited Lipka as allegedly providing evidence for the obviousness of the performing of the delta sigma modulation comprising performing 2nd order delta sigma modulation to output 4 bits from a 10 bit input. This rejection is respectfully traversed for at least the following reasons.

Claim 1, upon which claims 4 and 6-9 are dependent, recites a method which includes performing delta sigma modulation on a digital quadrature signal, converting the modulated signal to an analog signal, converting the analog signal to an RF signal, and transmitting the RF signal. The performing of the delta sigma modulation comprises performing 2nd order delta sigma modulation to output 4 bits from a 10 bit input.

Claim 10 recites a system including means for performing delta sigma modulation on a digital quadrature signal, means for converting the modulated signal to an analog signal, means for converting the analog signal to an RF signal, and means for transmitting the RF signal. The means for performing delta sigma modulation comprises means for performing 2nd order delta sigma modulation to output 4 bits from a 10 bit input.

Claim 11, upon which claims 14 and 16-19 are dependent, recites an RF transmitter comprising a delta sigma modulator capable of performing delta sigma modulation on a digital quadrature signal. The RF transmitter further includes a DAC, communicatively coupled to the delta sigma modulator, capable of converting the modulated signal to an analog signal, a mixer, communicatively coupled to the DAC, capable of converting the analog signal to an RF signal, and an antenna, communicatively coupled to the mixer, capable of transmitting the RF signal. The delta sigma modulator comprises a 2nd order delta sigma modulator configured to output 4 bits from a 10 bit input.

Therefore, embodiments of the invention provide a system and method that use less hardware and power than conventional transmitters without substantially reducing clarity of the data carried in the RF signals.

As will be discussed below, the Office Action has failed to provide a prima facie case for obviousness in view of Pikkarainen and Lipka.

Pikkarainen discloses a modulation method and modulator with which a complex signal can be modulated and shifted directly from the baseband frequency to an intermediate frequency or even directly from the baseband frequency to the transmission frequency. This is achieved by taking samples from the incoming bit stream with a D/A converter, preferably a sigma-delta type D/A converter, and selecting as output directly a multiple of the sampling frequency provided by the D/A converter. The conversion produces a baseband signal and signals at multiples of the sampling frequency. The sampling frequency is increased, according to a sigma-delta D/A conversion, and one of the signals at multiples of the sampling frequency, produced by the conversion, is selected as the output signal. A multiple at the D/A converter output that is at the desired intermediate frequency or at the transmission frequency is selected.

Lipka discloses providing sigma-delta modulators with a configurable output bit width so that the output bit width of the interpolation filters can be easily adapted to the input bit width of a chosen digital-to-analogue converter without the need to change the internal design of a baseband processing circuit.

Applicants respectfully submit that the Office Action has failed to provide a prima facie case for obviousness. In particular, the Office Action failed to provide any reasoning for why a person of ordinary skill in the art would be motivated to combine Pikkarainen and Lipka. Indeed, the Office Action does not mention any motivation whatsoever for combining Pikkarainen with Lipka. Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so. *In re Kahn*, 441, F.3d 977, 986, 78 USPQ2d 1329, 1335 (Fed. Cir. 2006). In other words, there must be a finding that there was some teaching, suggestion, or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to combine the reference teachings (see MPEP 2143).

Given that the Office Action has failed to articulate any motivation, either implicit or explicit, for combining Pikkarainen and Lipka, Applicants submit that the Office Action has failed to provide a prima facie case for obviousness. Accordingly, Applicants submit that the rejection of the claims under §103(a) is improper and should be withdrawn.

Furthermore, even assuming *arguendo* that a person of ordinary skill in the art would be motivated to combine Pikkarainen with Lipka, which is not admitted, Applicants submit that the combination of Pikkarainen and Lipka would not disclose or suggest all of the elements of the present claims. For example, Pikkarainen and Lipka, whether considered individually or combined, do not disclose or suggest, at least,

"wherein the performing of the delta sigma modulation comprises performing 2nd order delta sigma modulation to output 4 bits from a 10 bit input," as recited in claim 1 and similarly recited in claim 10. Similarly, the combination of Pikkarainen and Lipka fails to disclose or suggest that "the delta sigma modulator comprises a 2nd order delta sigma modulator configured to output 4 bits from a 10 bit input," as recited in claim 11. Thus, according to embodiments of the invention as recited in the present claims, the delta sigma modulators 240a and 240b are second order delta sigma modulators that output 4 bits from a 10 bit input (see Specification, paragraph 0025 and Figure 2).

Applicants respectfully submit that the combination of Pikkarainen and Lipka does not disclose or suggest second order delta sigma modulators that output 4 bits from a 10 bit input. Rather, Pikkarainen merely discloses that, in sigma-delta D/A converters, the sampling frequency is first increased by interpolating and then the number of bits in the samples is decreased, whereby a stream of words containing several bits can be converted to a stream of 1-bit words (Pikkarainen, Column 4, lines 51-55). Additionally, Pikkarainen specifically discloses that the "signals obtained from the interpolators/sinc filters 90 are further taken to sigma-delta modulators 91 (noise shaping blocks), which provide at their outputs 1-bit signals" (Pikkarainen, Column 5, lines 54-56, and Figure 5). Thus, Pikkarainen merely discloses sigma-delta modulators that provide a 1-bit output.

The Office Action acknowledged that Pikkarainen does not disclose 2nd order delta sigma modulation (see Response to Arguments section). Pikkarainen only mentions 1st or 5th order delta sigma modulation. The Office Action, however, concluded that it

would have been obvious to a person of ordinary skill in the art to modify Pikkarainen to utilize 2nd order delta sigma modulation because using a higher order delta sigma modulation will result in higher signal to noise ratio (see Office Action, page 5). Applicants submit that, even if it were obvious to a person of ordinary skill in the art to modify Pikkarainen to include a 2nd order delta sigma modulator (which is not admitted), it would not have been obvious to a person of ordinary skill in the art to modify Pikkarainen to include a 2nd order delta sigma modulator that outputs 4 bits from a 10 bit input. As outlined above, Pikkarainen merely discloses sigma-delta modulators that provide a 1-bit output.

The Office Action alleged, in the Response to Arguments section, that one of ordinary skill in the art would recognize that reducing the number of bits of the digital quadrature signal from 10 bits to 4 bits at the output of the delta sigma modulator is merely a matter of design requirement and cited Lipka in support of this assertion. Lipka, however, merely discloses that "the usage of digital-to-analogue converters with a higher number of input bits also makes it possible to use a lower over-sampling factor. Among others this has a positive effect on power consumption. On the other hand one might have to face a drawback in accuracy by an increase phase error between the samples of the in-phase and quadrature samples" (Lipka, Column 2, lines 45-53). Thus, Lipka merely suggests the use of a digital-to-analogue converters with a higher number of input bits, which may result in a positive effect on power consumption but also result in an increase

phase error. However, Lipka, like Pikkarainen does not disclose or suggest second order delta sigma modulators that output 4 bits from a 10 bit input.

Therefore, Applicants respectfully submit that the combination of Pikkarainen and Lipka does not disclose or suggest, at least, "wherein the performing of the delta sigma modulation comprises performing 2nd order delta sigma modulation to output 4 bits from a 10 bit input," as recited in claim 1 and similarly recited in claim 10. Similarly, the combination of Pikkarainen and Lipka fails to disclose or suggest that "the delta sigma modulator comprises a 2nd order delta sigma modulator configured to output 4 bits from a 10 bit input," as recited in claim 11. Therefore, Applicants respectfully request that the rejection of claims 1, 10 and 11 be withdrawn.

Claims 4, 6-9, 14, and 16-19 are dependent upon claims 1 and 11, respectively. As such, claims 4, 6-9, 14, and 16-19 should be allowed for at least their dependence upon claims 1 and 11, and for the specific limitations recited therein.

Claims 6 and 16 were rejected under 35 U.S.C. §103(a) as being unpatentable over Pikkarainen et al, in view of Lipka, and further in view of Hossack (US 6,819,276). This rejection is respectfully traversed for at least the following reasons.

Pikkarainen and Lipka are discussed above. Hossack discloses a noise-shaper system which includes a scrambler coupled to receive the output of a randomizer. The randomizer has an input for receiving a plurality of parallel equally weighted bits in a first sequence, and a first output which provides said bits in a pseudorandom sequence with a transformation that is not dependant on said first sequence. The scrambler is

coupled to receive the randomizer's output and, in response, to produce a second non-pseudorandom sequence of the bits at a second output with a transformation that is dependent on the pseudorandom sequence. The resultant output is noise shaped to reduce distortion.

Claims 6 and 16 are dependent upon claims 1 and 11, respectively. As discussed above, Pikkarainen and Lipka fail to disclose or suggest all of the elements of claims 1 and 11. Furthermore, Hossack fails to cure the deficiencies in Pikkarainen and Lipka as Hossack also fails to disclose or suggest 2nd order delta sigma modulation that outputs 4 bits from a 10 bit input. Thus, the combination of Pikkarainen, Lipka and Hossack does not disclose or suggest all of the elements of claims 6 and 16. Additionally, claims 6 and 16 should be allowed for at least its dependence upon claims 1 and 11, and for the specific limitations recited therein.

Claims 7 and 17 were rejected under 35 U.S.C. §103(a) as being unpatentable over Pikkarainen et al., in view of Lipka, and further in view of Norsworthy et al. (US 5,512,898). This rejection is respectfully traversed for at least the following reasons.

Pikkarainen and Lipka are discussed above. Norsworthy discloses a data converter which includes an analog-to-digital converter for converting an incoming analog signal into a plurality of digital signal samples, followed by a minimum phase FIR filter to filter the digital signal samples. Alternatively, the data converter includes a digital-to-analog converter preceded by a minimum phase FIR filter to filter a plurality of digital signal samples that are converted into an analog signal by the digital-to-analog

converter. The data converter may include both analog-to-digital and digital-to-analog conversion.

Claims 7 and 17 are dependent upon claims 1 and 11, respectively. As discussed above, Pikkarainen and Lipka fail to disclose or suggest all of the elements of claims 1 and 11. Furthermore, Norsworthy fails to cure the deficiencies in Pikkarainen and Lipka as Norsworthy also fails to disclose or suggest 2^{nd} order delta sigma modulation that outputs 4 bits from a 10 bit input. Thus, the combination of Pikkarainen, Lipka and Norsworthy does not disclose or suggest all of the elements of claims 7 and 17. Additionally, claims 7 and 17 should be allowed for at least their dependence upon claims 1 and 11, and for the specific limitations recited therein.

Claims 9 and 19 were rejected under 35 U.S.C. §103(a) as being unpatentable over Pikkarainen et al., in view of Lipka, and further in view of Fujimori (US 6,236,912). This rejection is respectfully traversed for at least the following reasons.

Pikkarainen and Lipka are discussed above. Fujimori discloses an analog-to-digital converter for converting an analog signal to a one-bit digital bit stream. The analog-to-digital converter uses a multi-bit analog delta-sigma modulator coupled to receive the analog input signal, and a one-bit digital delta-sigma modulator coupled to receive the digital output from the multi-bit analog delta-sigma modulator. The analog delta-sigma modulator uses a multi-bit quantizer having minimal quantization noise, and the digital delta-sigma modulator converts the multi-bit quantizer output into a single bit

delta-sigma digital format compatible with digital audio systems which require a one-bit delta-sigma format.

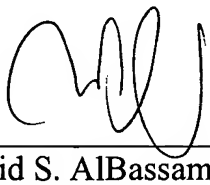
Claims 9 and 19 are dependent upon claims 1 and 11, respectively. As discussed above, Pikkarainen and Lipka fail to disclose or suggest all of the elements of claims 1 and 11. Furthermore, Fujimori fails to cure the deficiencies in Pikkarainen and Lipka as Fujimori also fails to disclose or suggest 2nd order delta sigma modulation that outputs 4 bits from a 10 bit input. Thus, the combination of Pikkarainen, Lipka and Fujimori does not disclose or suggest all of the elements of claims 9 and 19. Additionally, claims 9 and 19 should be allowed for at least their dependence upon claims 1 and 11, and for the specific limitations recited therein.

For at least the reasons discussed above, Applicants respectfully submit that the Office Action failed to provide a proper prima facie case for obviousness. Accordingly, Applicants submit that the rejections are improper and should be withdrawn. It is therefore respectfully requested that all of claims 1, 4, 6-11, 14, and 16-19 be allowed, and this application passed to issue.

If for any reason the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, the applicants' undersigned representative at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

In the event this paper is not being timely filed, the applicants respectfully petition for an appropriate extension of time. Any fees for such an extension together with any additional fees may be charged to Counsel's Deposit Account 50-2222.

Respectfully submitted,



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